

FIXED-FILM DIGESTERS

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- **The choice of which digester design to use at a given livestock operation is driven by the existing, or planned, manure handling system.**





Hydraulic Flushing



- **Conventional anaerobic digestion using complete-mix or plug-flow technologies is neither practical nor economical in this situation.**



- **The dilute manure streams (typically $< 1\%$ TS) would require excessively large digester volumes and higher heat inputs.**



Fixed-film Digestion

- A practical alternative is to apply high-rate anaerobic digestion technology, such as fixed-film digestion.



Fixed-film Digestion

- The basic fixed-film digester design consists of a tank packed with inert media on which a consortia of bacteria attach and grow as a biofilm
 - hence the term:

fixed-film digester



Fixed-film Digestion

- **Immobilization of the bacteria as a biofilm prevents washout of slower growing cells and provides biomass retention independent of hydraulic retention time (HRT).**



Fixed-film Digestion

- **The fixed-film design is suitable for any livestock waste that is subject to dilution with water for transport or processing.**



Wastewater Considerations

- **Strength**
- **Biodegradability**
- **Particulates**



Wastewater Characterization

- Temperature
- pH
- Conductivity
- Alkalinity
- Total COD
- Soluble COD
- Total solids
- Volatile solids
- Total suspended solids
- Volatile suspended solids
- Total Kjeldahl nitrogen
- Ammonia
- Total phosphorus
- Soluble reactive phosphorus
- Sulfate





Fixed-film Anaerobic Digester

100,000 gals.



Design Inputs

- **Number of animals / degree of confinement**
- **Feed ration / DMI**
- **Wastewater volume / characteristics**
- **Bedding material**
- **Solids separation**





Manure Handling



Performance

- **About half of the volatile solids in the flushed dairy manure is removed during pretreatment by mechanical separation and sedimentation.**



Performance

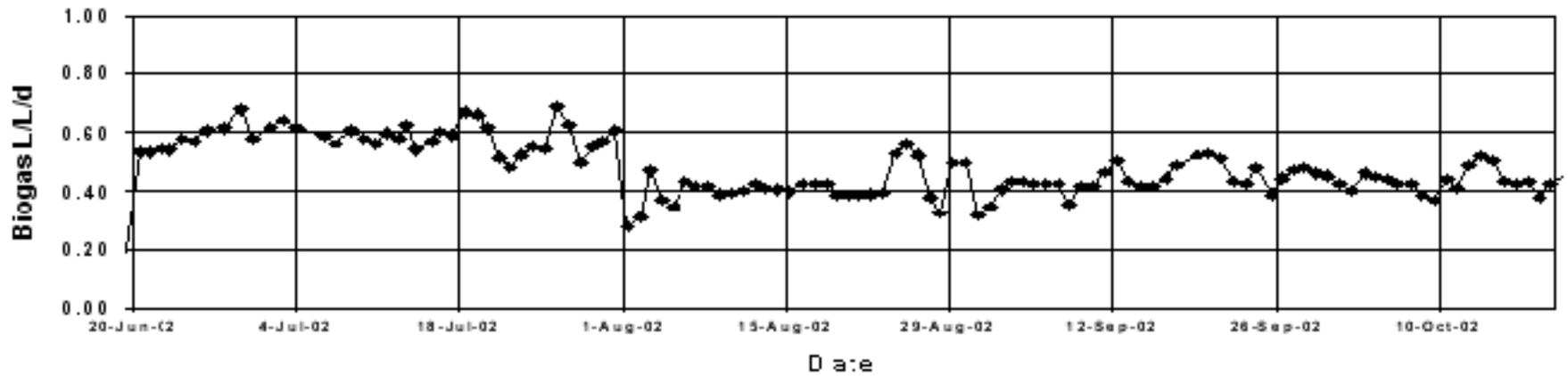
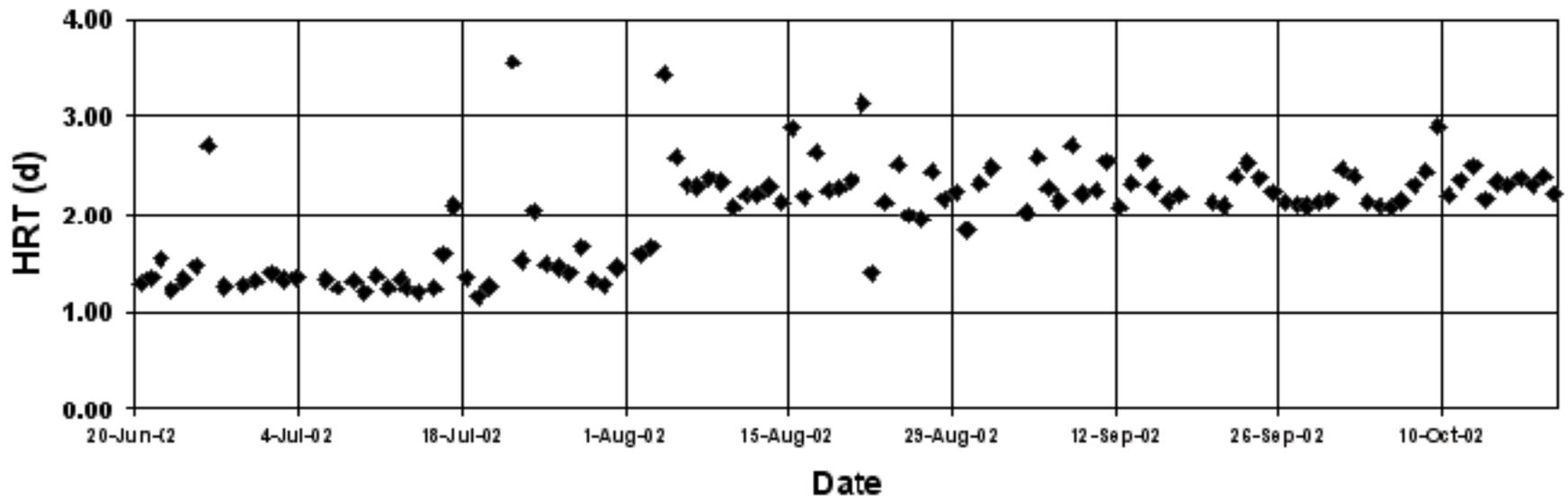
- **Fixed-film anaerobic digestion of the resulting wastewater removes 50% of the remaining COD at a 3-day HRT.**

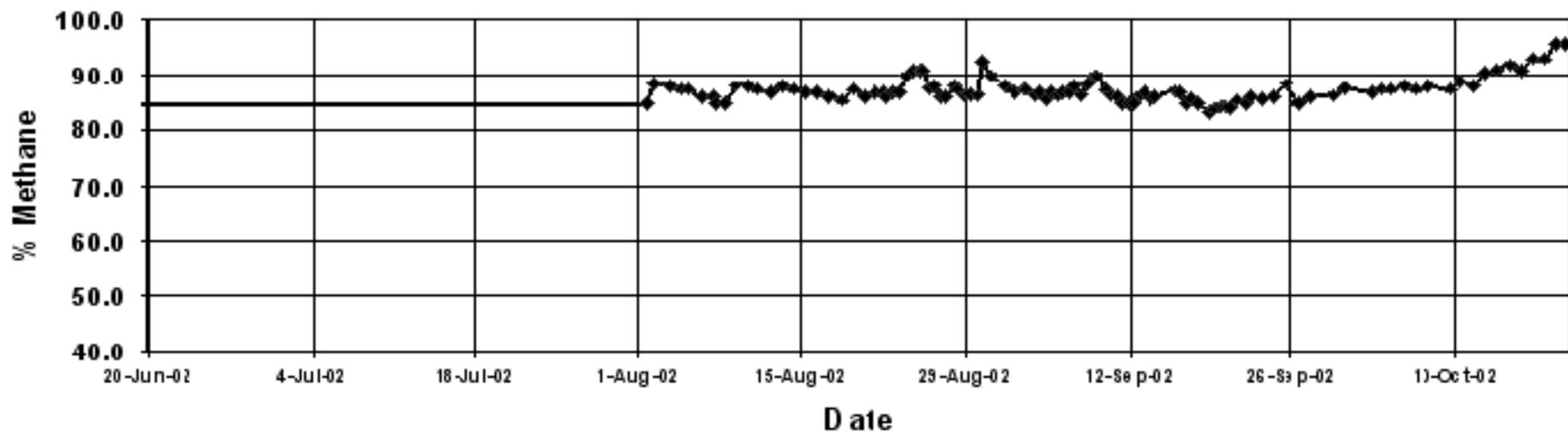
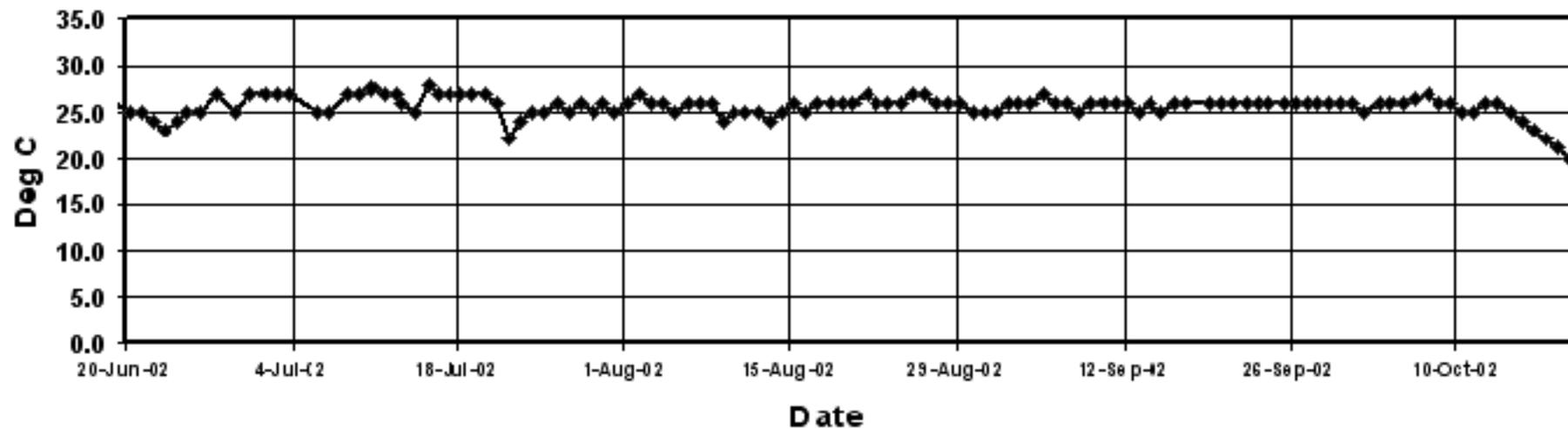


Biogas Quality

- **80% methane**
- **20% carbon dioxide**







Basic Equipment

- **Digester tank**
- **Feed pump**
- **Recycle pump**
- **Sludge pump**
- **Mass flow meter (biogas)**
- **Flare train**





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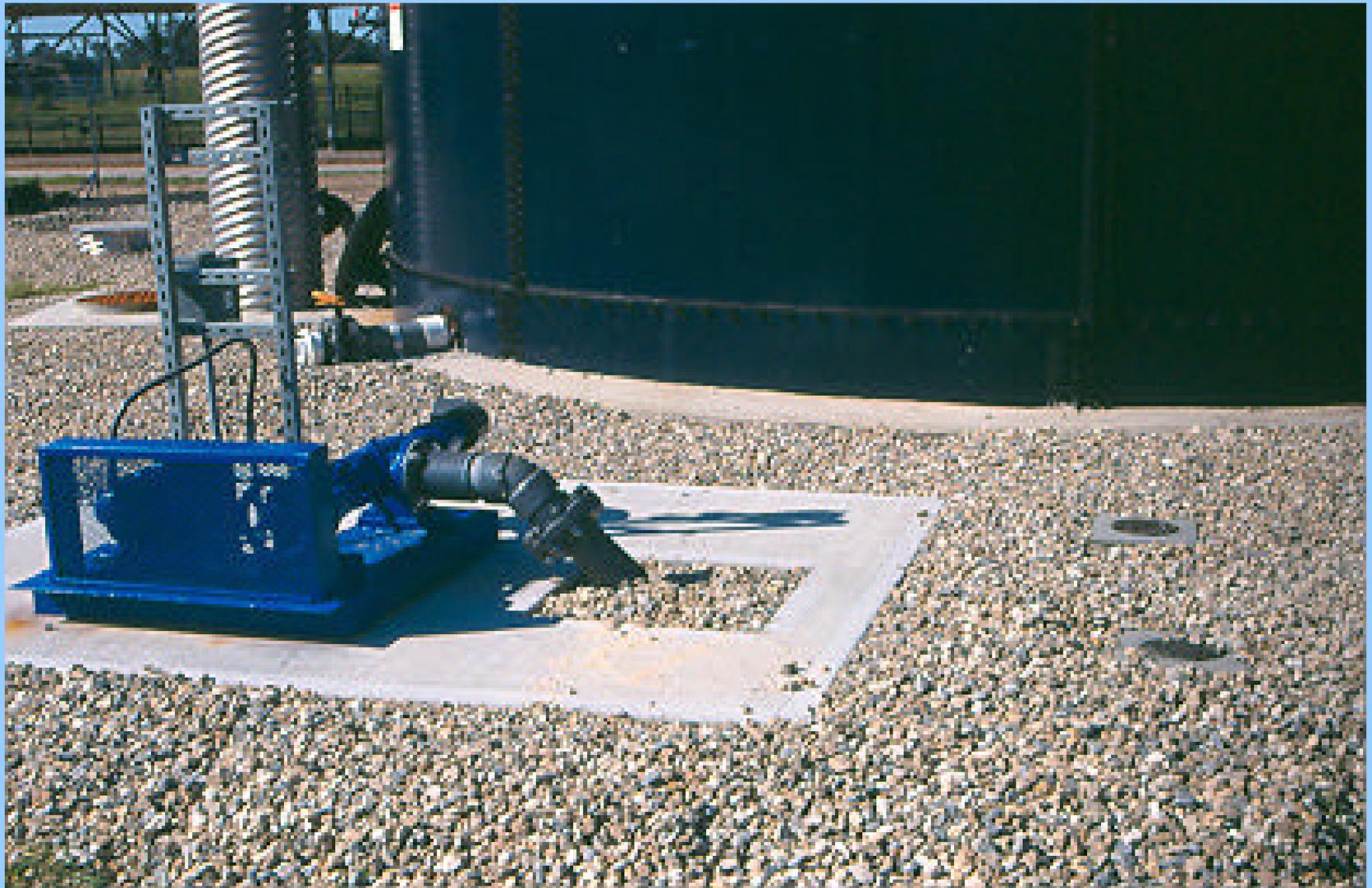
Feed Pump





Recycle Pump





Sludge Pump





Mass Flow Meter (biogas)





Flare Train



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